



Caltrans Division of Research,
Innovation and System Information

Research Results

Maintenance

NOVEMBER 2013

Project Title:

Validation of Rehabilitation Strategies
to Extend the Service Life of Concrete
Bridge Decks

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Product Category: New simulation and
improved decision support tool

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Extending the Service Life of Concrete Bridge Decks

Testing rehabilitation techniques to maintain highway bridge decks

WHAT WAS THE NEED?

Deterioration of highway bridge decks—the driving surface—is an ongoing concern for transportation agencies across the country. The deck's concrete is subject to cracking, affecting its lifespan. Currently, the standard design life for a highway bridge is 75 years, but the service life of the deck is 40 years or less. Replacing a deck is difficult, unreliable, and expensive.

The standard method of controlling cracks is using high molecular weight methacrylate (HMWM). The preferred full deck rehabilitation strategy is a polyester overlay. However, the long-term effectiveness of these techniques has not been fully validated nor has the optimum time to apply the treatments been established in terms of preservation and economic return.

WHAT WAS OUR GOAL?

The goal was to determine the effectiveness of methacrylate in extending the longevity of bridge decks and what is the best timing and condition to apply rehabilitation and preservation treatments.



Edge of decks clamped to tester to simulate box girder frame

Full-scale decks cast to Caltrans specifications



DRISI provides solutions and knowledge that improve California's transportation system.

WHAT DID WE DO?

To research the effectiveness of methacrylate overlays on top of cracked decks without removing the cover concrete, Caltrans, in partnership with the Montana State University Western Transportation Institute, engineered and assembled a simulator to test concrete decks built to Caltrans specifications. Eight full-sized deck panels (four sets) were cast and fixed to a support structure to model a box girder configuration, the design used for many California bridges. The researchers used an automated, 20-kip rolling wheel load simulator to replicate actual traffic loads on the panels (up to 2,000,000 load cycles). They applied HMWM to three panel sets at different traffic levels—simulating various stages of bridge deck deterioration—to determine whether treatments have an increased effectiveness based on time of application. One panel set was used as an untreated control.

The research addressed:

- Load cycle versus deterioration data for optimizing the timing of rehabilitation strategies
- Parameters that affect the success of each rehabilitation strategy
- Effectiveness of methacrylate on strength and durability of cracked bridge decks under rolling loads

WHAT WAS THE OUTCOME?

The researchers evaluated performance according to the cracking behavior and flexural stiffness of the test panels over time. Based solely on traffic-induced stresses and not environmental-induced deterioration, performance comparisons generally indicated that later applications of HMWM result in greater structural benefit. This result was most evident in the deck panels that were treated at 1,000,000 load cycles and then trafficked for an additional million load cycles. The test panels treated at earlier times also showed a benefit, but to a much lesser extent.

WHAT IS THE BENEFIT?

California has a highway bridge inventory of over 12,300 structures, and Caltrans spends millions of dollars every year to maintain and rehab them. Knowing when to apply a deck rehab method at the most beneficial bridge age and deck condition to extend its longevity can provide substantial cost savings. The engineering results of this study will be used to further test and compare different methods and evaluate the cost benefits.

LEARN MORE

To view the complete report:

www.dot.ca.gov/research/researchreports/reports/2013/Caltrans_Bridge_Deck_HMWM_Rehabilitation_Final_Report.pdf



Testing being performed with a 20,000 pound rolling load



LCPE Instruments recording deflection